

Dynamics during a transient gelation process studied by XPCS

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Aggregation and gelation are topics of fundamental interest in condensed matter physics that also have many direct industrial applications. Transient gelation is a non-equilibrium phenomenon (also known as *delayed sedimentation*) that can be found in colloidal suspensions with strong-enough short-ranged attractive interactions. Due to the interactions, the colloidal particles can aggregate at much lower concentrations (20 %) than those leading to the formation of glasses in hard-sphere systems (60 %), to form a space-filling structure often denoted a gel. However, this non-equilibrium structure slowly evolves, until the spatial connectivity is lost and the gel suddenly collapses.

A common generic behavior of disordered soft-matter systems such as colloidal glasses and gels is the presence of several dynamical relaxation mechanisms. The fast(er) ones correspond to the confined motion of individual particles or aggregates in cages or clusters created by neighboring particles/aggregates. Because the clustering can lead to structural arrest, such systems are generally non-ergodic. It is through the slow relaxations, corresponding to structural rearrangements equivalent to the α process in glasses that the system eventually can reach equilibrium and ergodicity may be restored.

In this paper we study the slow, non-equilibrium dynamics during transient gelation by X-ray photon correlation spectroscopy (XPCS). The intermediate scattering functions change during the process from stretched to compressed exponential decays indicating a jamming of the system in the full aging regime. A complex aging behavior towards the final collapse of the gel is observed and we propose that large scale network deformations trigger an un-jamming process leading to the collapse.